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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE EFFECT OF RESEARCH IN GENETICS ON THE ART OF BREEDING[1]

THE knowledge of breeding has advanced so rapidly in recent years that few of us realize the great change that has taken place in our understanding of the fundamental principles, and the effect that this change has had on the methods of practical breeding which we advocate. I had the good fortune to begin my studies and experiments in breeding in 1890, ten years before the rediscovery of Mendel's now famous principles of heredity, or the publication of de Vries's mutation theory. I have thus had the opportunity to follow this change through all its ramifications. From a condition of ignorance and largely of chaos, where all advance was taken as a lucky chance, we have developed to a position where practically each step may be taken intelligently. True, we touch the limits of knowledge on every hand and many of the most fundamental problems still remain unsolved, yet our understanding to-day, which enables us to analyze a plant into its component parts or characters, and then in turn by synthesis to build up a new structure by the combination of different characters into a new race or variety, is to our former understanding as light to darkness. The knowledge of breeding has developed into the science of genetics, and is fast assuming through the orderly presentation and classification of facts, the form of an exact science. Yet with all this advance in our understanding,

[1] Paper No. 27, Department of Plant Breeding, Cornell University, Ithaca, New York. Annual address of retiring chairman of the Plant Section, American Breeders' Association.

melt a coating of ice one inch in thickness in two hours and a quarter. Langley, about 1880 devised the "bolometer," an electrical thermometer so delicate that differences of temperature of less than one hundred-millionth of a degree can be detected. This instrument, as perfected and used by Langley and Abbot, has revolutionized the methods of studying the character and amount of heat received from the sun. The latest researches of Abbot and the Smithsonian Institution show that if the sun's rays could be completely employed to melt ice they would suffice to melt a coating one inch thick in one hour and thirty-eight minutes, or a layer 426 feet thick in a year.

Abbot's book is a study of the latest researches on the light and heat of the sun, of the sources from which that body derives its apparently inexhaustible supply of energy, and of the methods and instruments by means of which the great advances in knowledge have been made. It is a book by an active and successful worker in the field of solar investigation, a particularly sane and successful worker. The simple astronomical facts regarding the size, shape and distance of the sun, the phenomena of the visible surface, the rotation and the spots, are reviewed at length, but the feature of the book is the exhaustive treatment of all questions connected with the sun's action as a fountain of light and heat.

As to what the sun really is, Abbot is a strong advocate of the theory of a purely gaseous body (except sun spots). That the sun is mainly gaseous has been the accepted theory, but most writers and investigators have considered the visible surface as semi-fluid, as a sort of cloudlike formation floating in the outer gaseous envelopes. Sunspots are regarded by Abbot as cyclonic storms, or vortices, similar in form to water spouts seen at sea, the whirl carrying gases from below upward. The rapid uprush of the gases and the spreading out into the trumpet shape top, cause a rapid expansion and great cooling. This cooling carries the temperature down, and allows the formation of liquids, and thus the spots may be cloudlike forms, with some liquid and even solid particles. The peculiar periodicity of the spots in number and size is as yet unexplained. As to the source of the sun's heat and energy, Abbot shows that we may still regard Helmholtz's contractive hypothesis as adequate to satisfy the requirements of geology and physics. He is not carried off his feet by the popular scientific craze of explaining everything as a phase of radio-activity. Radio-active processes may have contributed somewhat to the store of solar energy, but that they have been any appreciable factor has not yet been shown.

The book is well written and is full of interesting matter for the scientist and for the general student. In it are tabulated and brought together the results of many researches, some hitherto unpublished, and others only to be found in special journals; the various hypotheses of solar physics are clearly set forth, and the merits and defects of each explained. It is the best work on the subject that has appeared for many years and will rank with and take the place of the similar book, by the late Charles A. Young, which for so many years was regarded as the standard treatise on "The Sun."

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SCIENTIFIC JOURNALS AND ARTICLES

THE March issue of *Terrestrial Magnetism and Atmospheric Electricity* contains the following articles:

"Ueber den elektrischen Strom Erde-Luft und seinen Zusammenhang mit den Erdströmen und den Schwankungen des erdmagnetischen Feldes," A. Gockel.

"Results of Magnetic Observations made by the United States Coast and Geodetic Survey at the Time of the Solar Eclipse of April 28, 1911," O. H. Tittmann.

"Magnetic Declinations and Chart Corrections in the Indian Ocean Continued," L. A. Bauer and W. J. Peters.

"Die Verteilung der Leitfähigkeit der Atmosphäre über dem grossen Ocean nach den Beobachtungen der *Galilee*," A. Nippoldt.

"Determination of the Pole Distance of a very Small Magnet" (abstract), J. M. Miller.